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(54) **PLANETARY TRANSMISSION HAVING PLANET CARRIER WITH THRUST PLATE CONFIGURED TO AID IN RETAINING PINS TO CARRIER BODY**

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F16H 57/08 (2006.01)
F16H 1/32 (2006.01)

(52) **U.S. Cl.**
CPC ***F16H 57/082*** (2013.01); ***F16H 1/32*** (2013.01); *F16H 57/021* (2013.01); *F16H 2001/325* (2013.01); *F16H 2001/327* (2013.01); *F16H 2057/085* (2013.01)

(58) **Field of Classification Search**
CPC F16H 57/082; F16H 1/32; F16H 2001/327; F16H 2001/325; F16H 2057/085
See application file for complete search history.

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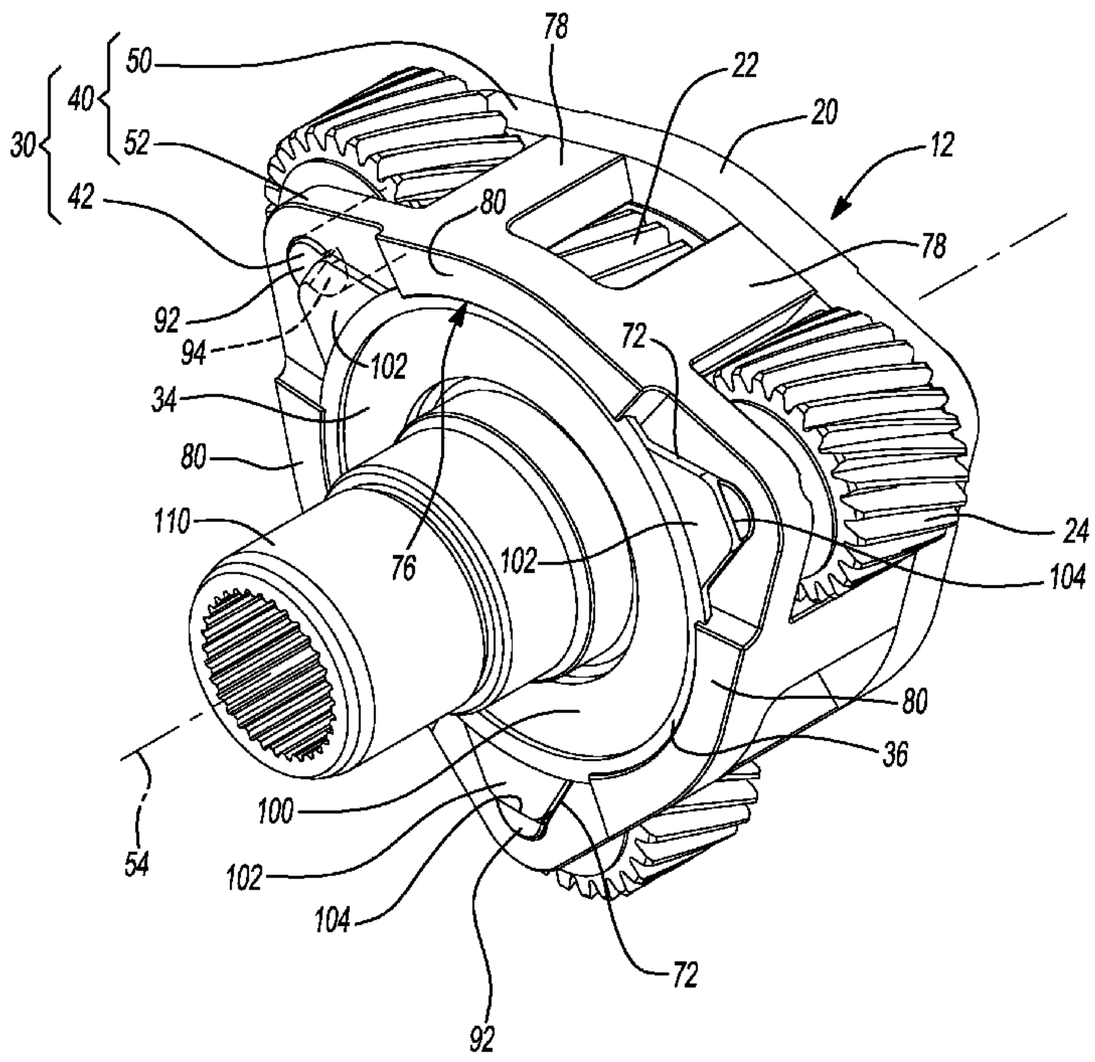
(57) **ABSTRACT**

A planetary transmission with a carrier body, a plurality of pins, a retaining ring and a thrust plate. The carrier body defines a plurality of pin apertures, which are disposed concentrically about a central axis, and a ring groove into which the retaining ring is received. Each of the pins has a stepped axial end that defines first and second axial end surfaces that are spaced apart from one another. The pins are received into the pin apertures such that the first axial end surface extends from the carrier body. The thrust plate has a plate body and a plurality of tabs that extend radially outwardly from the plate body. Each of the tabs overlies the second axial end surface of an associated one of the pins such that the thrust plate is disposed along the central axis between the second axial end surfaces and the retaining ring.

15 Claims, 4 Drawing Sheets



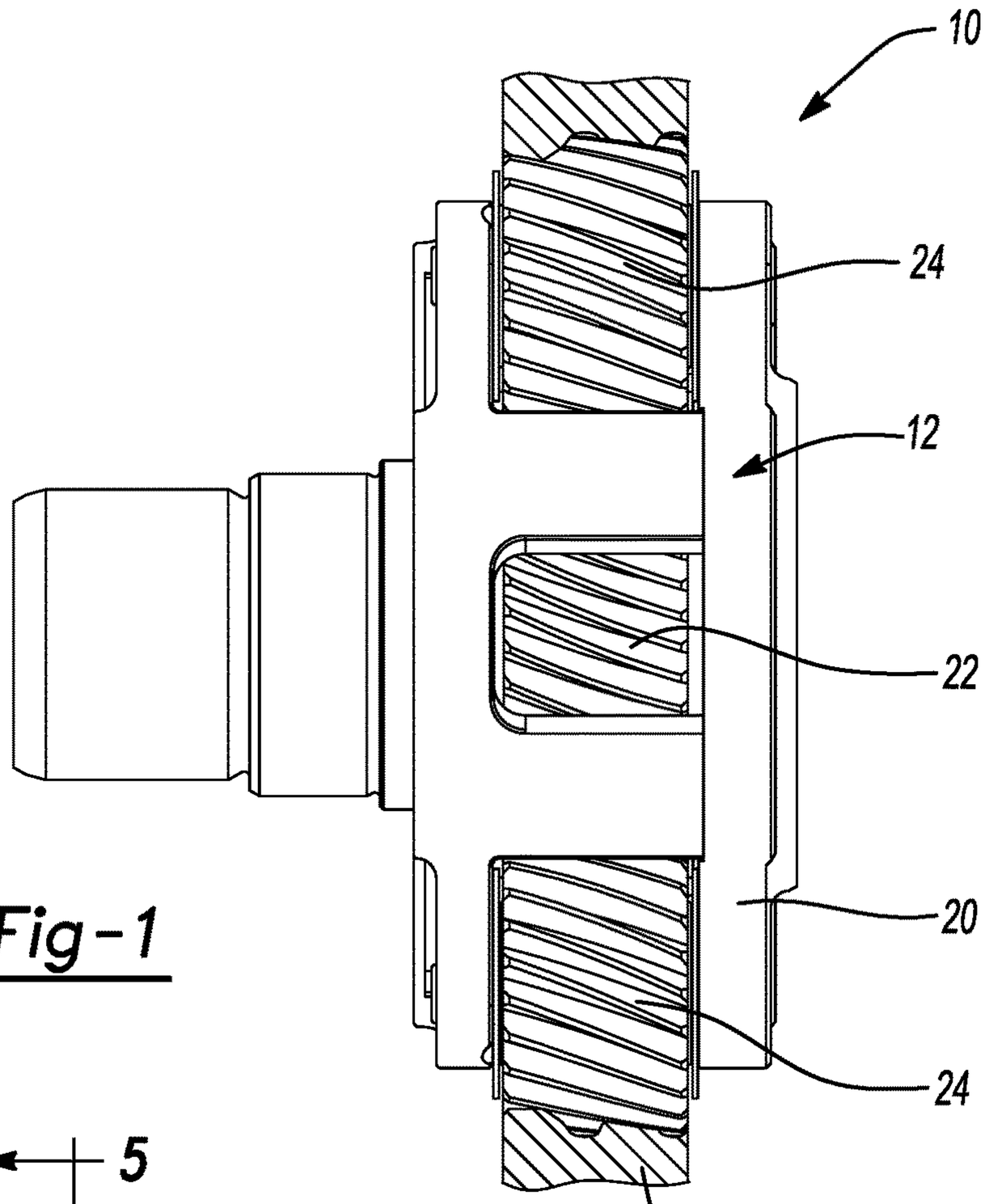


Fig-1

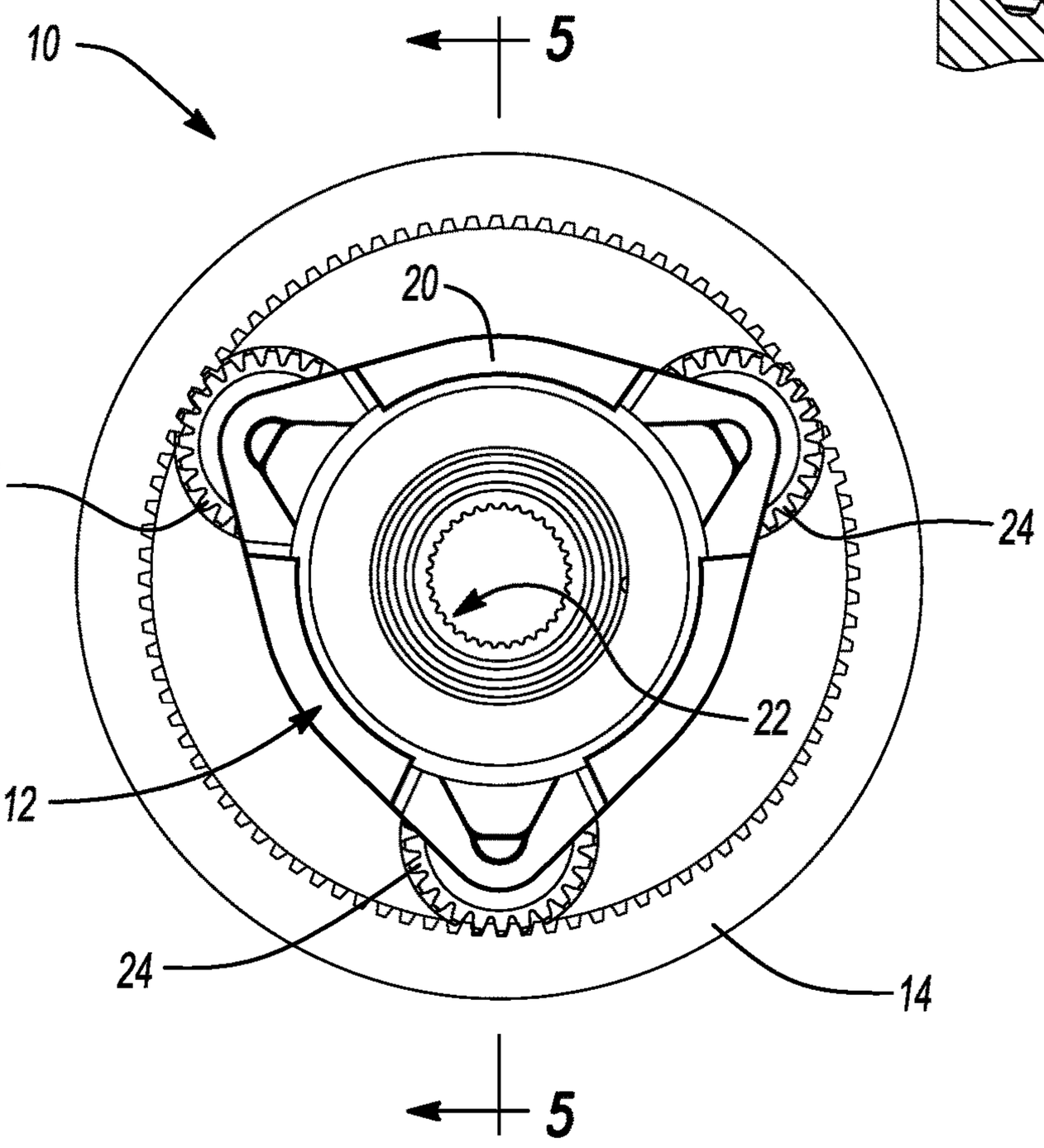


Fig-2

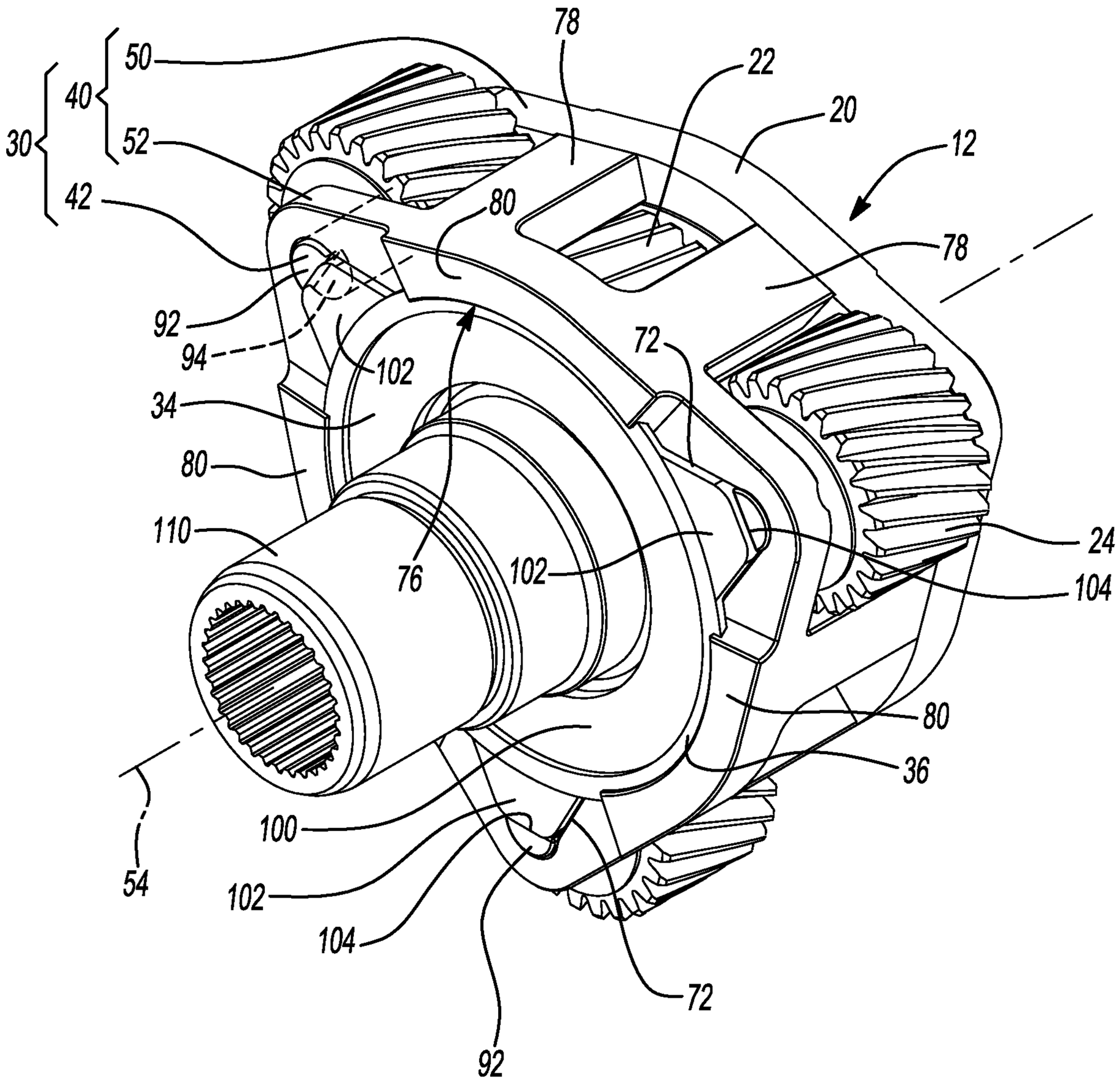

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Fig-3

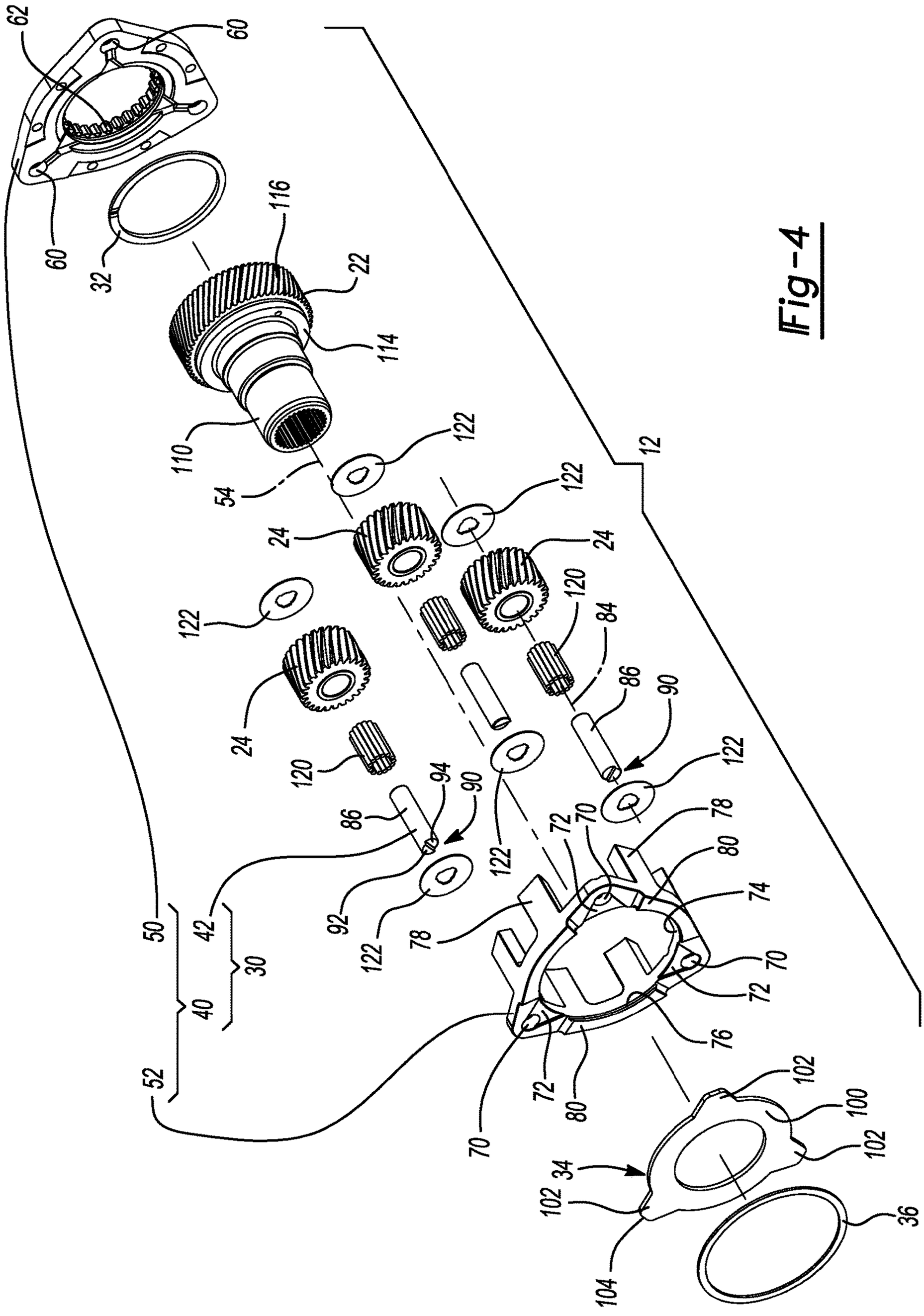
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Fig-4

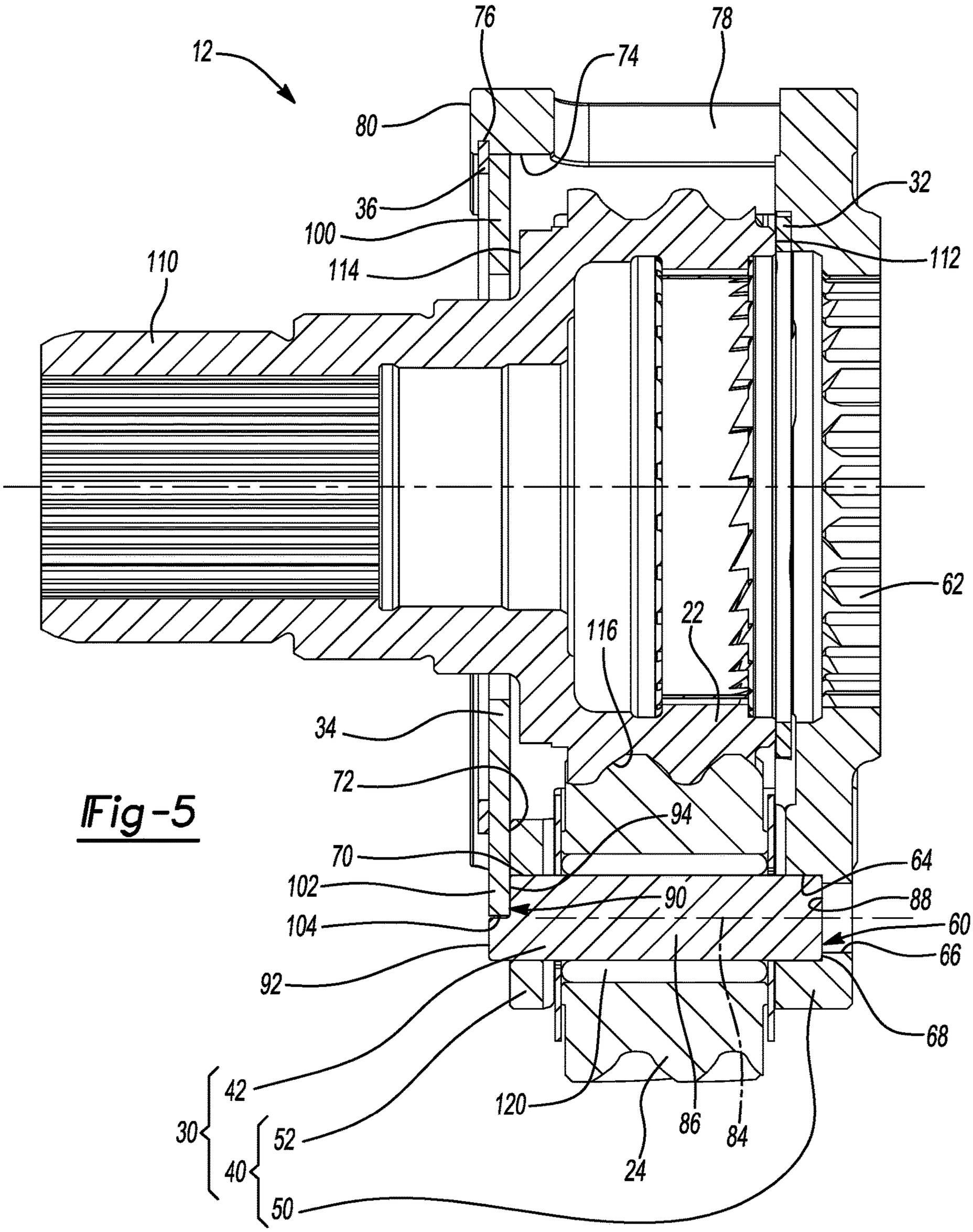
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Fig-5

PLANETARY TRANSMISSION HAVING PLANET CARRIER WITH THRUST PLATE CONFIGURED TO AID IN RETAINING PINS TO CARRIER BODY

FIELD

The present disclosure relates to a planetary transmission having a planet carrier with a thrust plate that is configured to aid in retaining pins to a carrier body.

BACKGROUND

This section provides background information related to the present disclosure which is not necessarily prior art.

Planetary transmissions typically include a planet carrier that journally supports a plurality of planet gears that can be meshed with a sun gear and/or a ring gear. The planet carrier includes a carrier body and a plurality of pins on which the planet gears are received. The pins can be supported on one or both of their axial ends by the carrier body depending on the magnitude of the rotary load that is transmitted between the planet gears and the pins. Rotation of the pins about their longitudinal axes relative to the carrier body is typically not desirable, but can occur with some planet carrier configurations, especially when the planetary transmission transmits relatively large rotary loads. Various strategies have been conceived to resist relative rotation between the pins and the carrier body, including the use of an interference fit between the pins and the carrier body. While such configurations can be effective, they can frequently be difficult to service in the event that components housed in the carrier body need replacement.

SUMMARY

This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

In one form, the present disclosure provides a planetary transmission with a carrier body, a plurality of pins, a retaining ring and a thrust plate. The carrier body has first and second plate members that each define a plurality of pin apertures that are disposed concentrically about a central axis. The second plate member defining a retaining ring groove. Each of the pins has a longitudinal pin axis and a stepped axial end that defines first and second axial end surfaces that are spaced apart from one another along the longitudinal pin axis. Each of the pins is received into a respective one of the pin apertures in the first plate member and a respective one of the pin apertures in the second plate member such that the first axial end surface extends from the second plate member on a side of the second plate member opposite the first plate member. The retaining ring is received in the retaining ring groove. The thrust plate has a plate body and a plurality of tabs that extend radially outwardly from the plate body. Each of the tabs overlies the second axial end surface of an associated one of the pins such that the thrust plate is disposed along the central axis between the second axial end surfaces and the retaining ring.

In another form, the present disclosure provides a method for assembling a planetary transmission. The method includes: providing a carrier body that defines a central axis; assembling pins and planet gears to the carrier body, each of the planet gears being disposed about an associated one of the pins, each of the pins having a longitudinal pin axis and a stepped axial end that defines first and second axial end surfaces that are spaced apart from one another along the longitudinal pin axis; inserting a sun gear through an assembly aperture in the carrier body; abutting a thrust plate to the carrier body, the thrust plate having a plate body and a plurality of tabs that extend radially outwardly from the plate body, each of the tabs overlying the second axial end surface of an associated one of the pins; and mounting a retaining ring into a ring groove formed in the carrier body to retain the thrust plate to the carrier body.

Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

FIG. **1** is a partly sectioned front elevation view of an exemplary planetary transmission constructed in accordance with the teachings of the present disclosure;

FIG. **2** is a rear view of the planetary transmission of FIG. **1**;

FIG. **3** is a perspective view of a portion of the planetary transmission of FIG. **1** illustrating a planet carrier cartridge in more detail;

FIG. **4** is an exploded perspective view of the planet carrier cartridge; and

FIG. **5** is a section view taken along the line **5**-**5** of FIG. **2**.

Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

With reference to FIGS. **1** through **3** of the drawings, a planetary transmission constructed in accordance with the teachings of the present disclosure is generally indicated by reference numeral **10**. The planetary transmission **10** can include a planet carrier cartridge **12** and a ring gear **14**. The planet carrier cartridge **12** can have a planet carrier assembly **20**, a sun gear **22**, and a plurality of planet gears **24**. In the example provided, the ring gear **14**, the sun gear **22** and the planet gears **24** are formed with helical gear teeth, but it will be appreciated that they could be formed with spur (straight) gear teeth in the alternative.

With reference to FIGS. **3** through **5**, the planet carrier assembly **20** can include a planet carrier **30**, a thrust washer **32**, a thrust plate **34** and a retaining ring **36**. The planet carrier **30** can include a carrier body **40** and a plurality of pins **42**. The carrier body **40** can include a first plate member **50** and a second plate member **52** that is spaced apart from the first plate member **50** along a central axis **54** to receive the planet gears **24** therebetween. In the example shown, the first and second plate members **50** and **52** are discrete components that are assembled to one another. More specifically, the first and second plate members **50** and **52** are formed of compacted powdered metal and are joined by brazing when the first and second plate members **50** and **52** are sintered. Thereafter, the first and second plate members **50** and **52** can be machined as a unit. It will be appreciated, however, that the first and second plate members **50** and **52** could be unitarily and integrally formed.

The first plate member **50** can define a plurality of first pin apertures **60** and an internally toothed aperture **62** that defines a plurality of teeth that are disposed concentrically about the central axis **54**. The first pin apertures **60** can be spaced concentrically about the central axis **54** and can have a stepped configuration with a first portion **64** and a second, smaller diameter portion **66**. A shoulder **68** can be formed where the first and second portions **64** and **66** intersect one another.

The second plate member **52** can define a plurality of second pin apertures **70**, a plurality of tab recesses **72**, an assembly aperture **74** and a retaining ring groove **76**. A plurality of spacing legs **78** can be coupled to (e.g., unitarily and integrally formed with) one of the first plate member **50** and/or the second plate member **52** and can contact the other one of the first plate member **50** and the second plate member **52** to space the first and second plate members **50** and **52** apart from one another along the central axis **54**. In the example provided, the spacing legs **78** are unitarily and integrally formed with the second plate member **52**. The second pin apertures **70** can be spaced concentrically about the central axis **54**. The tab recesses **72** are formed into an axial end of the second plate member **52** on a side that faces away from the first plate member **50**. Each of the tab recesses **72** intersects an associated one of the second pin apertures **70**. The assembly aperture **74** is formed through the second plate member **52** and is sized to permit the sun gear **22** to be inserted into the space between the first and second plate members **50** and **52**. The retaining ring groove **76** is formed into the second plate member **52** concentrically about the central axis **54**. In the example provided, the retaining ring groove **76** is formed in a discontinuous manner by three circumferentially extending rib members **80** and is disposed radially inwardly of the second pin apertures **70**.

Each of the pins **42** can extend along a longitudinal pin axis **84** and can have a pin body **86** with a first axial end **88** and a second axial end **90**. The second axial end **90** can be stepped so as to have a first axial end surface **92** and a second axial end surface **94** that are spaced apart from one another along the longitudinal pin axis **84**. Each of the pins **42** can be received into one of the first pin apertures **60** in the first plate member **50** and one of the second pin apertures **70** in the second plate member **52**. In the example provided, the pin bodies **86** are received in a slip-fit manner into the first and second pin apertures **60** and **70** and the first axial ends **88** of the pins **42** are abutted against the shoulders **68** formed by the first pin apertures **60**. Configuration in this manner inhibits movement of the pins **42** along the longitudinal pin axes **84** relative to the first plate member **50** in a direction away from the second plate member **52**. It will be appreciated, however, that a press-fit or interference fit between the pins **42** and the first pin apertures **60** and/or the second pin apertures **70** could be employed to secure the pins **42** to the first plate member **50** and/or the second plate member **52**. The first axial end surfaces **92** of the pins **42** can extend along the central axis **54** past the axial end of the second plate member **52** that faces away from the first plate member **50**. The second axial end surfaces **94** of the pins **42** can be disposed along the central axis **54** at a desired location, such as flush or below the portions of the axial end of the second plate member **52** that define the bottom surfaces of the tab recesses **72**.

The thrust plate **34** has a plate body **100** and a plurality of tabs **102** that extend radially outwardly from the plate body **100**. In the example provided, the plate body **100** has an annular shape and is smaller in diameter than the assembly aperture **74** in the second plate member **52**. The tabs **102** are received into the tab recesses **72** in the second plate member **52** and overlie the second axial end surfaces **94** of the pins **42**. The tabs **102** and the tab recesses **72** can be shaped in a corresponding manner to limit or inhibit relative rotation between the thrust plate **34** and the carrier body **40**. In the example provided, the tabs **102** and tab recesses **72** have a triangular shape. Radially outer edges **104** of the tabs **102** cooperate with the portions of the pins **42** that extend between the first and second axial end surfaces **92** and **94** to inhibit or limit rotation of the pins **42** about the longitudinal pin axes **84** relative to the carrier body **40**. The tabs **102** can be formed so as to be offset along the central axis **54** relative to the plate body **100**. Configuration in this manner permits the plate body **100** to be received into the assembly aperture **74** while the tabs **102** are received in the tab recesses **72** and overlie the second axial end surfaces **94** on the pins **42**.

The retaining ring **36** is placed into the assembly aperture **74** and received in the retaining ring groove **76** in the second plate member **52** and secures the thrust plate **34** to the carrier body **40**. The retaining ring **36** abuts the plate body **100** on a side of the thrust plate that faces away from the pins **42**. Accordingly, the securing of the thrust plate **34** to the carrier body **40** via the retaining ring **36** also limits or inhibits movement of the pins **42** relative to the carrier body **40** along the central axis **54** in a direction away from the first plate member **50**. It will be appreciated that the retaining ring **36** is disposed radially inwardly of the pins **42**.

The sun gear **22** is rotatable about the central axis **54** and shown in the example provided as being unitarily and integrally formed with a shaft member **110**. The sun gear **22** includes first and second thrust surfaces **112** and **114**, respectively, and a plurality of sun gear teeth **116**. The thrust washer **32** can be received in the space between the first and second plate members **50** and **52** and can be disposed between the first thrust surface **112** on the sun gear **22** and the first plate member **50**. The second thrust surface **114** on the sun gear **22** can be disposed adjacent an associated thrust surface on the plate body **100** on the thrust plate **34**. Accordingly, the thrust washer **32** accommodates thrust forces between the sun gear **22** and the carrier body **40** in a first direction along the central axis **54**, while the plate body **100** accommodates thrust forces between the sun gear **22** and the carrier body **40** in a second, opposite direction along the central axis **54**.

Each of the planet gears **24** is disposed between the first and second plate members **50** and **52** and is rotatably received on an associated one of the pins **42**. In the example provided, needle bearings **120** are received between the pins **42** and the planet gears **24** and thrust washers **122** are received on the pins **42** between the first and second plate members **50** and **52** and respective axial ends of the planet gears **24**. The planet gears **24** can be meshingly engaged to the sun gear **22** and the ring gear **14** (FIG. **2**).

The present disclosure also provides a method for assembling a planetary transmission **10**. The method includes: providing a carrier body **40** that defines a central axis **54**; assembling pins **42** and planet gears **24** to the carrier body **40**, each of the planet gears **24** being disposed about an associated one of the pins **42**, each of the pins **42** having a longitudinal pin axis **84** and a stepped axial end **90** that defines first and second axial end surfaces **92** and **94**, respectively, that are spaced apart from one another along the longitudinal pin axis **84**; inserting a sun gear **22** through an assembly aperture **74** in the carrier body **40**; abutting a thrust plate **34** to the carrier body **40**, the thrust plate having a plate body **100** and a plurality of tabs **102** that extend

radially outwardly from the plate body **100**, each of the tabs **102** overlying the second axial end surface **94** of an associated one of the pins **42**; and mounting a retaining ring **36** through the assembly aperture **74** and into a retaining ring groove **76** formed in the carrier body **40** to retain the thrust plate **34** to the carrier body **40**.

The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

What is claimed is:

1. A planetary transmission comprising:

a carrier body having first and second plate members, each of the first and second plate members defining a plurality of pin apertures that are disposed concentrically about a central axis, the second plate member defining a retaining ring groove;

a plurality of pins, each of the pins having a longitudinal pin axis and a stepped axial end that defines first and second axial end surfaces that are spaced apart from one another along the longitudinal pin axis, each of the pins being received into a respective one of the pin apertures in the first plate member and a respective one of the pin apertures in the second plate member such that the first axial end surface extends from the second plate member on a side of the second plate member opposite the first plate member;

a retaining ring received in the retaining ring groove; and

a thrust plate having a plate body and a plurality of tabs that extend radially outwardly from the plate body, each of the tabs overlying the second axial end surface of an associated one of the pins such that the thrust plate is disposed along the central axis between the second axial end surfaces and the retaining ring.

2. The planetary transmission of claim **1**, wherein the second plate member defines a plurality of tab recesses, each of the tabs being received in an associated one of the tab recesses.

3. The planetary transmission of claim **2**, wherein the tabs are triangular in shape.

4. The planetary transmission of claim **1**, wherein the plate body has an annular shape.

5. The planetary transmission of claim **1**, wherein an assembly aperture is formed in the second plate member, the assembly aperture being sized to receive the retaining ring there through, wherein the plate body is smaller than the assembly aperture.

6. The planetary transmission of claim **1**, wherein the retaining ring is disposed radially inwardly of the pins.

7. The planetary transmission of claim **1**, wherein the first and second plate members are fixedly coupled to one another independently of the pins.

8. The planetary transmission of claim **1**, further comprising a plurality of planet gears, each of the planet gears being rotatably disposed on a corresponding one of the pins.

9. The planetary transmission of claim **8**, further comprising a plurality of bearings, each of the bearings being received between a respective one of the pins and a respective one of the planet gears.

10. The planetary transmission of claim **8**, further comprising a sun gear meshingly engaged to the planet gears.

11. The planetary transmission of claim **10**, wherein the plate body is larger in diameter than the sun gear.

12. The planetary transmission of claim **11**, wherein sun gear and the thrust plate have associated thrust surfaces and wherein the sun gear is slidable between the first and second plate members so that the thrust surface on the sun gear contacts the thrust surface on the thrust plate.

13. The planetary transmission of claim **1**, wherein the first plate member defines a plurality of teeth that are disposed concentrically about the central axis.

14. The planetary transmission of claim **1**, wherein each of the pins has a shoulder that is seated axially against the first plate member.

15. The planetary transmission of claim **1**, wherein the pins engage the pin apertures in at least one of the first and second plate members in a slip fit manner.

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